MEMORANDUM REPORT ARLCB-MR-83046

MANUFACTURE OF SPLIT RING BREECH SEALS

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DECEMBER 1983

US ARMY ARMAMENT RESEARCH AND DEVELOPMENT CENTER
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Split Ring Breech Seal
Hydraulic Kinking Machine
Splitting the Ring
Polishing Split Surfaces

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

An engineering survey relative to the problems associated with split ring manufacturing was undertaken. The results of this effort are as follows:

1. Kinking: A hydraulically operated kinking machine has been built in-house. Initial testing is very promising. Modification and refinements to this unit are continuing.

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20. ABSTRACT (CONT'D)

2. Splitting the Ring: The feasibility of splitting the ring using an electrical discharge machine "EDM" was investigated. A service contract for EDM cutting employing a traveling wire electrode was awarded. This method proved unsatisfactory for production application. A specification for an automated abrasive saw has been prepared. This machine will have power clamping, adjustable cutting feeds, constant surface feet per minute "SFM" wheel control, wheel guides for stability and self-contained coolant system.

3. Polishing Split Surface: The engineering study failed in locating an adaptable state of the art polishing machine that would meet the rigid requirements of our components. In order to improve on our present method of polishing, an in-house effort has been undertaken. Two wet belt sanders have been purchased and the modification for our application has begun.

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BACKGROUND AND INTRODUCTION

The split ring is a precisely manufactured complex item which provides a gas seal in the breech of a cannon. The present manufacturing methods, which have been used since the development of the split ring, require considerable hand finishing and highly skilled personnel.

Each breech mechanism containing a rotary block such as the 175mm gun, 8" Howitzer, and 155mm Howitzer must have a safe and reliable pressure sealing system. The primary components of this system are obturator pads and split rings. The split ring is a gas sealing component having an ability to open and close along a slit which is cut at an angle to the plane of the ring. When the ring is closed, contact must occur over 80 percent of the mating surfaces of the slit. The split ring is a component having close tolerances. In its manufacture the ring is first roughed out, crimped, and slitted (the crimping operation gives the ring its spring back quality causing it to close). Next a series of finishing operations takes place involving closing the slit with solder, machining the ring, removing the solder, and hand finishing the slit mating surfaces. These operations are repeated at least twice. Manufacture of this component is difficult because distortions occur during the machining of the prestressed part and metal is removed in making the slit.

Hand benching is necessary to meet the fits required and results in high rework and a significant rejection rate. Current equipment requires hand benching to finish the split ring to size and specifications, which adds to the cost of manufacture.

APPROACH TO THE PROBLEM

Using funding appropriated in FY79, preliminary engineering was conducted to examine the present methods used in the manufacture of split rings.

This report is the culmination of an effort to examine the present methods of manufacturing split ring breech seals and to establish new manufacturing procedures and equipment to improve the quality and lessen the high rejection rates experienced using the present methods of machining.

Initial engineering analysis revealed that the manufacturing difficulties experienced are predominant in three machining operations: (1) Kinking, (2) Splitting and (3) Polishing the split surfaces. This report addresses those areas.

Kinking

Presently there are two procedures for kinking the ring. One uses the hot method and the other uses the cold kink method (see Appendix A). Both procedures are slow and lack consistency of finished product due to many variables. In order to minimize the errors associated with manual operations, a hydraulically operated kinking machine was built. The kinking force is supplied by a hydraulic unit which provides power to three hydraulic cylinders. Two cylinders are placed at the top of the fixture and supply the clamping force to the component, and a third cylinder is placed under the component and supplies the upward force to kink the ring. The three cylinders are controlled by a sequencing valve which activates the two clamping cylinders first. At a present pressure, a bypass valve opens and allows the hydraulic fluid to

activate the upward cylinder to kink the ring. An adjustable stop block has been provided that can be quickly set to accommodate rings requiring different amounts of offset. The return movement is accomplished by tripping of a microswitch.

The above described kinking machine has been assembled and preliminary testing has indicated the feasibility of its use. This testing has shown where improvements and refinements should be made. Upon completion of modifications, the testing will resume.

Splitting the Ring

The splitting operation as now performed (Figure 1) has caused problems since its introduction. The splitting saw is of the manual, pivotal arm type and the work holding fixture is outdated. The success of the splitting depends entirely on the skill of the operator. First he has to apply just the right amount of cutting pressure at initial contact of the abrasive wheel with the work and then maintain the pressure through the cut. Excessive pressure will cause the wheel to deflect, thereby causing an uneven kerf. This unevenness has to be corrected at the polishing operation. The greater the unevenness, the longer the polishing operation will take and very frequently excessive polishing will remove too much stock and the piece will have to be scrapped. Not enough pressure will cause excessive glazing which will also cause an uneven cut and component burn.

Another problem associated with the present saw is the inability to maintain the proper surface feet per minute "SFM" of the abrasive wheel as the wheel wears.

The outdated holding fixture previously mentioned is cumbersome to load and extremely difficult to adjust so that the split ring will not close in on the abrasive cutting wheel as the wheel breaks through the work.

In theory, if a ring could be split without removing any stock or if the width of the kerf could be substantially reduced, the amount of the kink could also be reduced or eliminated. To pursue this objective, it was decided to conduct testing with a traveling wire electric discharge machine, "Wire EDM".

A contract was awarded to a manufacturer of "EDM" machines to design and build a traveling wire attachment and special work holding fixture necessary to conduct tests on Government supplied rings.

Testing was conducted at the manufacturer's plant using tungsten, molybdenum, copper, and brass wire. The wire diameters ranged from 0.005 inch to 0.010 inch. All of the testing was done in the presence of a Government representative.

The extensive testing performed showed that although the split ring component can be cut using the traveling wire method, the extremely slow cutting rate renders this type of equipment impractical for our production requirements.

In order to accomplish a uniform cut and to remove the possibility of human error, a machine specification has been prepared which will automate the ring splitting operation.

The machine will have power clamping, adjustable cutting wheel feed controls, constant surface feet per minute "SFM" wheel control to compensate for wheel wear, wheel guides, and a self-contained coolant system.

Polishing of the Split Surfaces

The polishing of the split surface is a very critical operation that is performed by highly skilled operators (Figure 2). Each ring requires from one-half hour to one hour to polish. The highly skilled operations have become very difficult to replace, consequently a new method for polishing the cut has to be found.

Many inquiries have been made to manufacturers of polishing and lapping equipment regarding the application or adaptation of their equipment to our production needs. All of their replies have been negative, so it has been decided to manufacture our own polishing machine around a commercially built sander. Two wet belt sanders have been purchased and the modifications for our application have begun.

CONCLUSIONS

In order to improve the present method of manufacture of split rings and to lessen our dependence upon the services of highly skilled operators, capital equipment will be purchased with subsequent year's funding, in addition to the in-house effort of building new kinking equipment and polishing machines.

The production testing of this new equipment will be performed in-house and upon the successful completion of the individual equipment tests, the equipment will be turned over to the Arsenal Operations Division.

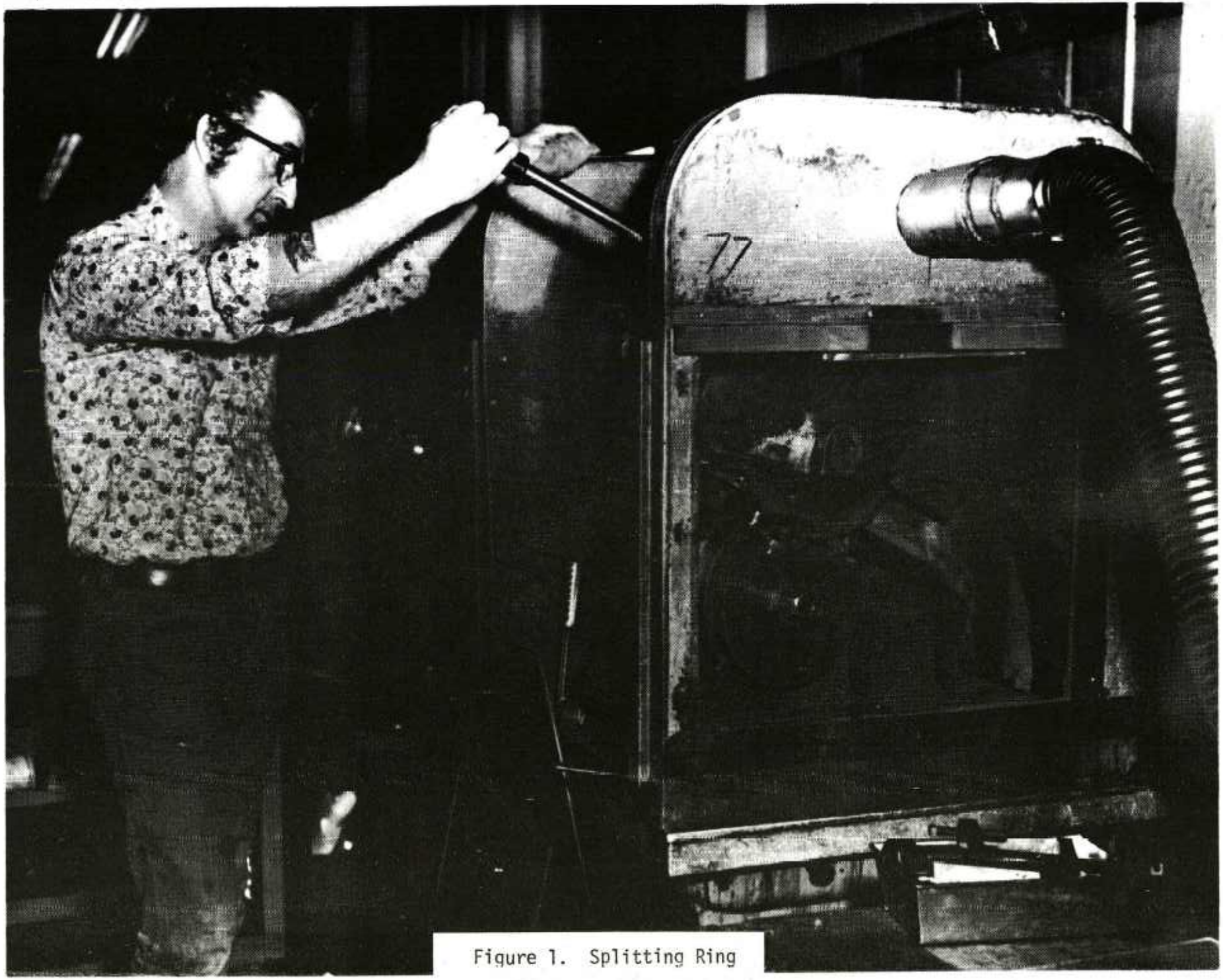

Figure 1. Splitting Ring

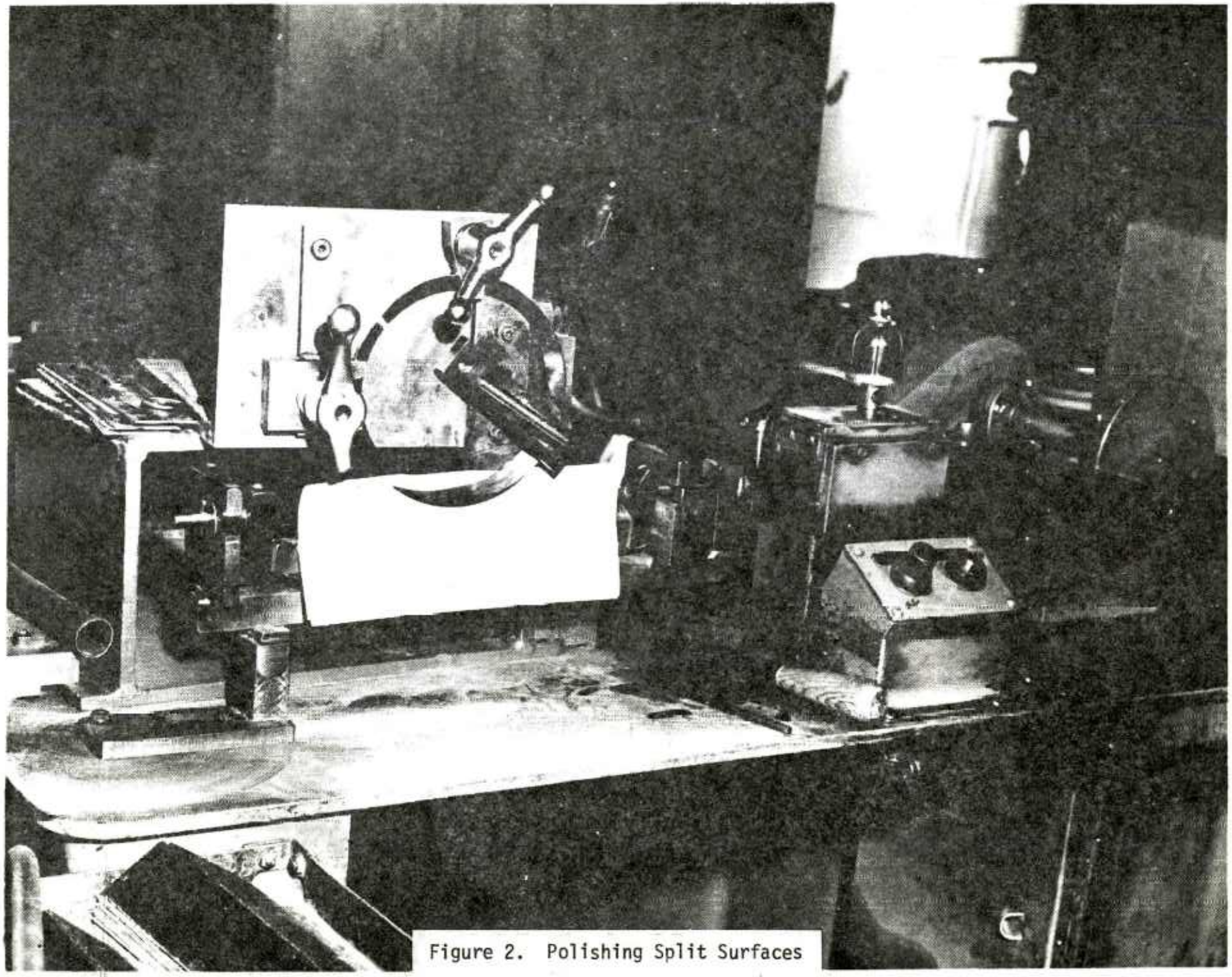

Figure 2. Polishing Split Surfaces

KINKING PROCEDURE OF SPLIT RINGS
HARDNESS RANGE RC 30-36

This is not a mandatory procedure

It is for information only

For

Split Rings

B6163456 - B6163457
B6163661 - B6163662
B6163998 - B6163999

Prepared by: Benet R&E Labs
Watervliet Arsenal

Appendix A

FORWARD:

"Kinking Procedure of Split Rings Hardness Range R_c 30-36" has been prepared for informational purposes only. It is intended as an aid to reduce learning curve lead time in the production of these components.

Due to the highly specialized nature of split ring manufacture, it is recommended that successful bidders review component route sheets and actual production operations at this installation.

The following is a procedure that is used at this Arsenal and is recommended to be used for kinking the split rings that have a Rockwell Hardness range of C30 - C36.

1. It is a must that the exact type of steel (carbon content, etc.) be known and a record of same be kept with the respective rings for heat treating purposes.

2. The hardening and tempering temperatures used must be recorded on the above record. This is necessary as the split ring is preheated prior to kinking and the preheat temperature is brought to a range of approximately 75°F. below the tempering temperature previously attained.

3. Following the hardening operation, the split ring is checked for the proper Rockwell requirements.

4. The rings are cleaned by sandblasting. This allows for a cleaner ring which provides a better fit when secured in their respective kinking jaws.

5. The split rings are preheated in an electric Lindberg Tempering furnace to a temperature of approximately 75°F below the tempering temperature.

6. The ring is removed from the furnace and is immediately placed in the jaws/vise type fixture and secured.

7. The time element is important as the heat loss must be kept to a minimum.

8. With the ring secured in its respective jaws, the special

Kinking Wrench is placed and secured on the split ring (safety lock on wrench must be used).

9. With Wrench in position, pressure is placed by downward motion so as to develop the required Kink.

10. It is recommended that the distance of downward pull be done in stages until the .090 recommended Kink is obtained. (The wrench will move approximately through an arc distance of 60°).

11. When the proper kink is obtained, the distance that the wrench must move is checked and a dimensional stop is applied for further kinking.

12. When the kink has been produced and the ring is still in its respective jaws, a mark is placed on the ring face denoting the point of tension. This is used for locating when ring is later split.

13. Upon completing above, ring is removed from the vise and allowed to cool.

14. The kink is checked by laying ring on a plate and placing a flat shim gage approximately 1/4" wide by .090" high under the kinked area and a similar gage at a location of 180° away from this point.

15. If correct kink (.090") is not obtained, the kinking procedure previously used should be repeated until the requirement has been met.

16. When the kinked rings have been cooled, they are again subjected to a sandblast cleaning operation.

17. An important point to be mentioned is that the tempering furnace must be in a close proximity to the kinking fixture and equipment.

18. It is also noted that the split ring must be machined so that a rigid hold is obtained when the ring is placed in the kinking jaws and vise type fixture.

19. This is necessary so a kinking action is obtained rather than a rolling or twisting type action.

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